



Acta Crystallographica Section E

Structure Reports

Online

ISSN 1600-5368

2-(2,6-Dichlorophenyl)-N-(1,3-thiazol-2-yl)acetamide

Prakash S. Nayak,^a B. Narayana,^a H. S. Yathirajan,^b
Jerry P. Jasinski^{c*} and Ray J. Butcher^d^aDepartment of Studies in Chemistry, Mangalore University, Mangalagangothri 574 199, India, ^bDepartment of Studies in Chemistry, University of Mysore, Manasagangothri, Mysore 570 006, India, ^cDepartment of Chemistry, Keene State College, 229 Main Street, Keene, NH 03435-2001, USA, and ^dDepartment of Chemistry, Howard University, 525 College Street NW, Washington, DC 20059, USACorrespondence e-mail: jjasinski@keene.edu

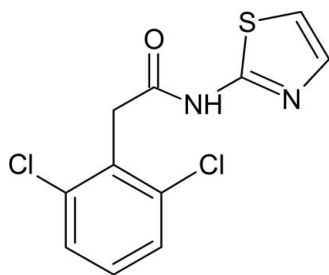
Received 4 March 2013; accepted 5 March 2013

Key indicators: single-crystal X-ray study; $T = 123$ K; mean $\sigma(\text{C}-\text{C}) = 0.002$ Å; R factor = 0.041; wR factor = 0.096; data-to-parameter ratio = 37.0.

In the title compound, $\text{C}_{11}\text{H}_8\text{Cl}_2\text{N}_2\text{OS}$, the mean plane of the dichlorophenyl ring is twisted by $79.7(7)^\circ$ from that of the thiazole ring. In the crystal, molecules are linked *via* pairs of $\text{N}-\text{H}\cdots\text{N}$ hydrogen bonds, forming inversion dimers which stack along the *a*-axis direction.

Related literature

For the structural similarity of N-substituted 2-arylacetamides to the lateral chain of natural benzylpenicillin, see: Mijin & Marinkovic (2006); Mijin *et al.* (2008). For the coordination abilities of amides, see: Wu *et al.* (2008, 2010). For related structures, see: Fun *et al.* (2012*a,b,c,d,e*); Butcher *et al.* (2013*a,b*). For standard bond lengths, see: Allen *et al.* (1987).



Experimental

Crystal data

 $\text{C}_{11}\text{H}_8\text{Cl}_2\text{N}_2\text{OS}$ $M_r = 287.15$ Triclinic, $P\bar{1}$ $a = 7.1278(4)$ Å $b = 8.4434(4)$ Å $c = 10.3637(6)$ Å $\alpha = 95.341(4)^\circ$ $\beta = 106.140(5)^\circ$ $\gamma = 96.745(4)^\circ$ $V = 589.80(6)$ Å³ $Z = 2$ Mo $K\alpha$ radiation $\mu = 0.71$ mm⁻¹ $T = 123$ K $0.3 \times 0.2 \times 0.1$ mm

Data collection

Agilent Xcalibur (Ruby, Gemini) diffractometer

Absorption correction: multi-scan (*CrysAlis RED*; Agilent, 2012) $T_{\min} = 0.909$, $T_{\max} = 1.000$

10674 measured reflections

5881 independent reflections

4481 reflections with $I > 2\sigma(I)$ $R_{\text{int}} = 0.025$

Refinement

 $R[F^2 > 2\sigma(F^2)] = 0.041$ $wR(F^2) = 0.096$ $S = 1.05$

5881 reflections

159 parameters

H atoms treated by a mixture of independent and constrained refinement

 $\Delta\rho_{\text{max}} = 0.63$ e Å⁻³ $\Delta\rho_{\text{min}} = -0.30$ e Å⁻³

Table 1

Hydrogen-bond geometry (Å, °).

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
$\text{N1}-\text{H1N}\cdots\text{N2}^i$	0.890 (19)	2.030 (19)	2.9165 (14)	173.9 (17)

Symmetry code: (i) $-x + 1, -y + 2, -z + 1$.

Data collection: *CrysAlis PRO* (Agilent, 2012); cell refinement: *CrysAlis PRO*; data reduction: *CrysAlis PRO*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL*.

BN thanks the UGC for financial assistance through a BSR one-time grant for the purchase of chemicals. PSN thanks Mangalore University for research facilities and the DST-PURSE financial assistance. RJB acknowledges the NSF-MRI program (grant No. CHE-0619278) for funds to purchase the X-ray diffractometer.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HG5297).

References

- Agilent (2012). *CrysAlis PRO* and *CrysAlis RED*. Agilent Technologies, Yarnton, England.
- Allen, F. H., Kennard, O., Watson, D. G., Brammer, L., Orpen, A. G. & Taylor, R. (1987). *J. Chem. Soc. Perkin Trans. 2*, pp. S1–19.
- Butcher, R. J., Mahan, A., Nayak, P. S., Narayana, B. & Yathirajan, H. S. (2013*a*). *Acta Cryst. E* **69**, o46–o47.
- Butcher, R. J., Mahan, A., Nayak, P. S., Narayana, B. & Yathirajan, H. S. (2013*b*). *Acta Cryst. E* **69**, o39.
- Fun, H.-K., Ooi, C. W., Nayak, P. S., Narayana, B. & Sarojini, B. K. (2012*a*). *Acta Cryst. E* **68**, o1312–o1313.
- Fun, H.-K., Quah, C. K., Nayak, P. S., Narayana, B. & Sarojini, B. K. (2012*b*). *Acta Cryst. E* **68**, o2679.
- Fun, H.-K., Quah, C. K., Nayak, P. S., Narayana, B. & Sarojini, B. K. (2012*c*). *Acta Cryst. E* **68**, o2464.
- Fun, H.-K., Quah, C. K., Nayak, P. S., Narayana, B. & Sarojini, B. K. (2012*d*). *Acta Cryst. E* **68**, o2461.
- Fun, H.-K., Quah, C. K., Nayak, P. S., Narayana, B. & Sarojini, B. K. (2012*e*). *Acta Cryst. E* **68**, o2565.
- Mijin, D. & Marinkovic, A. (2006). *Synth. Commun.* **36**, 193–198.
- Mijin, D. Z., Prasecivic, M. & Petrovic, S. D. (2008). *J. Serb. Chem. Soc.* **73**, 945–950.
- Sheldrick, G. M. (2008). *Acta Cryst. A* **64**, 112–122.
- Wu, W.-N., Cheng, F.-X., Yan, L. & Tang, N. (2008). *J. Coord. Chem.* **61**, 2207–2215.
- Wu, W.-N., Wang, Y., Zhang, A.-Y., Zhao, R.-Q. & Wang, Q.-F. (2010). *Acta Cryst. E* **66**, m288.

supporting information

Acta Cryst. (2013). E69, o523 [doi:10.1107/S1600536813006260]

2-(2,6-Dichlorophenyl)-N-(1,3-thiazol-2-yl)acetamide

Prakash S. Nayak, B. Narayana, H. S. Yathirajan, Jerry P. Jasinski and Ray J. Butcher

S1. Comment

N-Substituted 2-arylacetamides are very interesting compounds because of their structural similarity to the lateral chain of natural benzylpenicillin (Mijin *et al.*, 2006, 2008). Amides are also used as ligands due to their excellent coordination abilities (Wu *et al.*, 2008, 2010). Crystal structures of some acetamide derivatives viz., (2,2-diphenyl-N-(1,3-thiazol-2-yl)acetamide, 2-(4-chlorophenyl)-N-(1,3-thiazol-2-yl)acetamide, 2-(naphthalen-1-yl)-N-(1,3-thiazol-2-yl)acetamide, N-(1,3-thiazol-2-yl)-2-(2,4,6-trimethyl phenyl)acetamide, 2-(2-fluorophenyl)-N-(1,3-thiazol-2-yl)acetamide (Fun *et al.*, 2012*a,b,c,d,e*), 2-(2,6-dichlorophenyl)-N-(1,5-dimethyl-3-oxo-2-phenyl-2,3-dihydro-1H-pyrazol-4-yl)acetamide, 2-(2,4-Dichlorophenyl)-N-(1,5-dimethyl-3-oxo-2-phenyl-2,3-dihydro-1H-pyrazol-4-yl)acetamide (Butcher *et al.*, 2013*a,b*) have been reported. In view of the importance of amides, we report herein the crystal structure of the title compound, C₁₁H₈Cl₂N₂OS, (I).

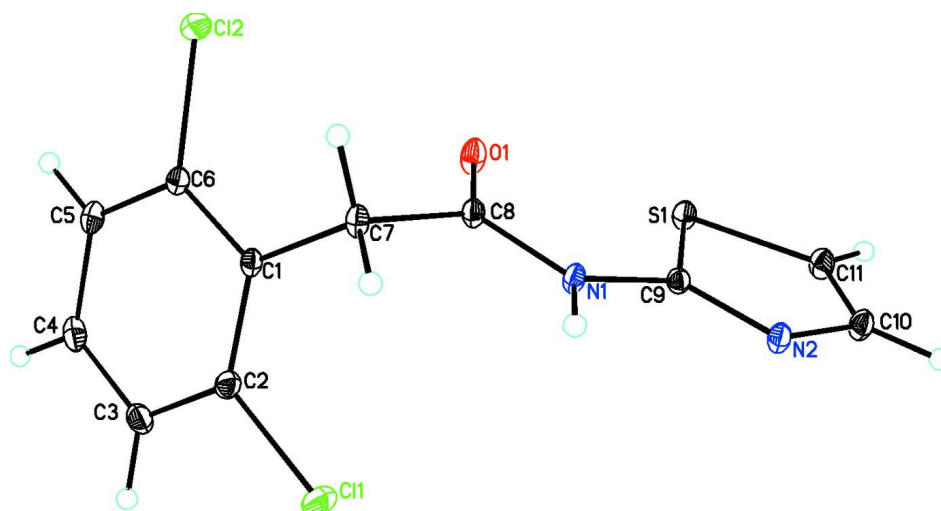
In (I), the mean plane of the dichlorophenyl ring is twisted by 79.7 (7)° from that of the thiazol ring (Fig. 1). Bond lengths are in normal ranges (Allen *et al.*, 1987) In the crystal, intermolecular N—H···N hydrogen bonds forming a R₂,2(8) graph-set orientation are observed (Table 1) which form infinite 1-D chains along [100] and add to packing stability (Fig. 2).

S2. Experimental

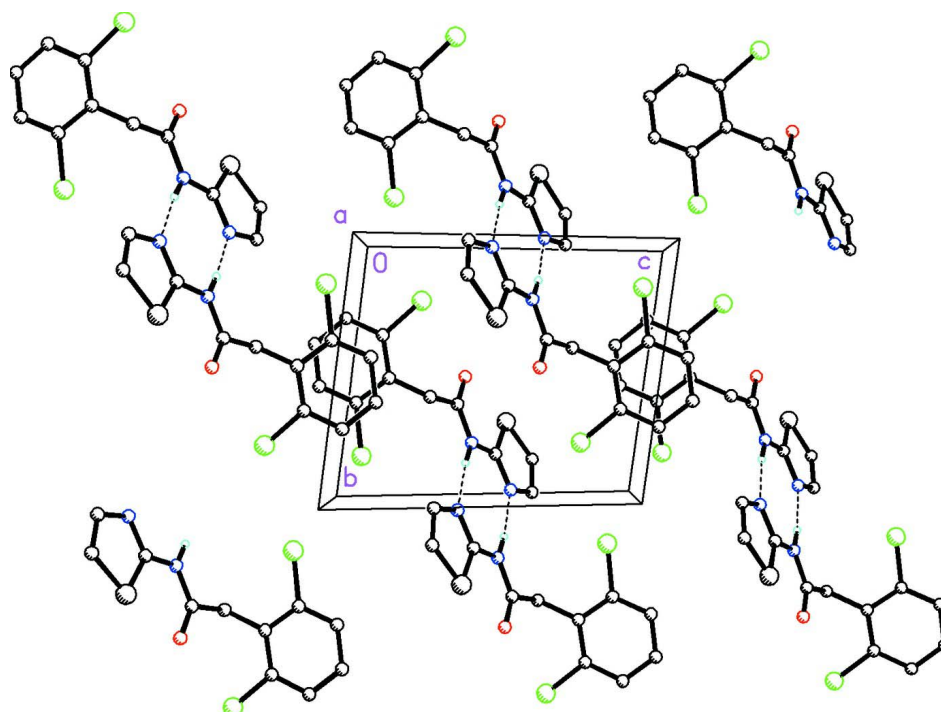
2,6-Dichlorophenylacetic acid (0.240 g, 1 mmol) and 2-aminothiazole (0.1 g, 1 mmol), 1-ethyl-3-(3-dimethylamino-propyl)-carbodiimide hydrochloride (1.0 g, 0.01 mol) and were dissolved in dichloromethane (20 mL). The mixture was stirred in presence of triethylamine at 273 K for about 3 h. The contents were poured into 100 ml of ice-cold aqueous hydrochloric acid with stirring, which was extracted thrice with dichloromethane (Fig. 3). The organic layer was washed with saturated NaHCO₃ solution and brine solution, dried and concentrated under reduced pressure to give the title compound (I). Single crystals were grown from methanol and acetone mixture (1:1) by the slow evaporation method (M.P.: 489–491K).

S3. Refinement

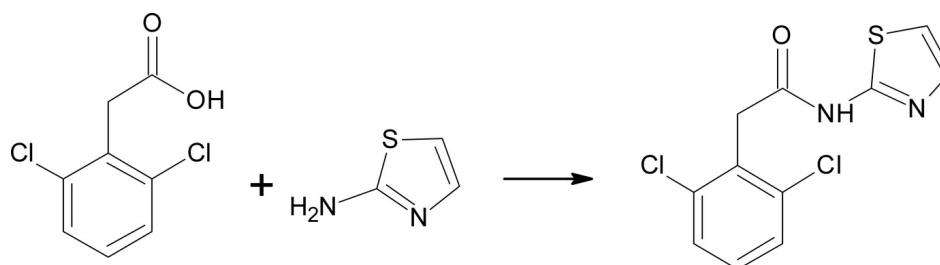
All of the H atoms were placed in their calculated positions and then refined using the riding model with Atom—H lengths of 0.95 Å (CH) or 0.99 Å (CH₂). Isotropic displacement parameters for these atoms were set to 1.18–1.23 (CH, CH₂) times *U*_{eq} of the parent atom.

**Figure 1**

Molecular structure of the title compound showing the atom labeling scheme and 30% probability displacement ellipsoids.

**Figure 2**

Packing diagram of the title compound viewed along the *a* axis. Dashed lines indicate N—H...N intermolecular hydrogen bonds which form chains along [100]. H atoms not involved in hydrogen bonding have been removed for clarity.

**Figure 3**

Reaction scheme.

2-(2,6-Dichlorophenyl)-N-(1,3-thiazol-2-yl)acetamide*Crystal data* $C_{11}H_8Cl_2N_2OS$ $M_r = 287.15$ Triclinic, $P\bar{1}$ Hall symbol: $-P\ 1$ $a = 7.1278\ (4)\ \text{\AA}$ $b = 8.4434\ (4)\ \text{\AA}$ $c = 10.3637\ (6)\ \text{\AA}$ $\alpha = 95.341\ (4)^\circ$ $\beta = 106.140\ (5)^\circ$ $\gamma = 96.745\ (4)^\circ$ $V = 589.80\ (6)\ \text{\AA}^3$ $Z = 2$ $F(000) = 292$ $D_x = 1.617\ \text{Mg m}^{-3}$ Mo $K\alpha$ radiation, $\lambda = 0.71073\ \text{\AA}$

Cell parameters from 3814 reflections

 $\theta = 3.1\text{--}37.5^\circ$ $\mu = 0.71\ \text{mm}^{-1}$ $T = 123\ \text{K}$

Prism, colorless

 $0.3 \times 0.2 \times 0.1\ \text{mm}$ *Data collection*Agilent Xcalibur (Ruby, Gemini)
diffractometer

Radiation source: Enhance (Mo) X-ray Source

Graphite monochromator

Detector resolution: $10.5081\ \text{pixels mm}^{-1}$ ω scansAbsorption correction: multi-scan
(*CrysAlis RED*; Agilent, 2012) $T_{\min} = 0.909$, $T_{\max} = 1.000$

10674 measured reflections

5881 independent reflections

4481 reflections with $I > 2\sigma(I)$ $R_{\text{int}} = 0.025$ $\theta_{\max} = 37.6^\circ$, $\theta_{\min} = 3.1^\circ$ $h = -12 \rightarrow 12$ $k = -13 \rightarrow 14$ $l = -17 \rightarrow 8$ *Refinement*Refinement on F^2

Least-squares matrix: full

 $R[F^2 > 2\sigma(F^2)] = 0.041$ $wR(F^2) = 0.096$ $S = 1.05$

5881 reflections

159 parameters

0 restraints

Primary atom site location: structure-invariant
direct methodsSecondary atom site location: difference Fourier
mapHydrogen site location: inferred from
neighbouring sitesH atoms treated by a mixture of independent
and constrained refinement $w = 1/[\sigma^2(F_o^2) + (0.0399P)^2 + 0.0356P]$ where $P = (F_o^2 + 2F_c^2)/3$ $(\Delta/\sigma)_{\max} = 0.001$ $\Delta\rho_{\max} = 0.63\ \text{e \AA}^{-3}$ $\Delta\rho_{\min} = -0.30\ \text{e \AA}^{-3}$

Special details

Geometry. All esds (except the esd in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell esds are taken into account individually in the estimation of esds in distances, angles and torsion angles; correlations between esds in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell esds is used for estimating esds involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted R -factor wR and goodness of fit S are based on F^2 , conventional R -factors R are based on F , with F set to zero for negative F^2 . The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating R -factors(gt) etc. and is not relevant to the choice of reflections for refinement. R -factors based on F^2 are statistically about twice as large as those based on F , and R -factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (\AA^2)

	<i>x</i>	<i>y</i>	<i>z</i>	$U_{\text{iso}}^*/U_{\text{eq}}$
S1	0.07341 (5)	0.70227 (3)	0.53736 (3)	0.01622 (7)
Cl1	0.33730 (6)	0.82751 (4)	0.07966 (4)	0.02553 (8)
Cl2	0.41255 (5)	0.22491 (3)	0.21194 (3)	0.02086 (7)
O1	0.23281 (15)	0.51841 (10)	0.38090 (10)	0.02131 (19)
N1	0.38161 (16)	0.77833 (11)	0.43229 (10)	0.01460 (18)
H1N	0.472 (3)	0.854 (2)	0.4214 (18)	0.033 (5)*
N2	0.30837 (16)	0.97170 (11)	0.58210 (10)	0.01568 (18)
C1	0.36862 (17)	0.52292 (13)	0.13841 (11)	0.01338 (19)
C2	0.29093 (19)	0.61876 (14)	0.03922 (13)	0.0166 (2)
C3	0.1754 (2)	0.55517 (16)	−0.09107 (13)	0.0203 (2)
H3A	0.1266	0.6242	−0.1559	0.024*
C4	0.1326 (2)	0.38945 (16)	−0.12497 (13)	0.0203 (2)
H4A	0.0532	0.3444	−0.2135	0.024*
C5	0.20517 (19)	0.28927 (14)	−0.03037 (13)	0.0183 (2)
H5A	0.1757	0.1757	−0.0536	0.022*
C6	0.32131 (18)	0.35632 (13)	0.09860 (12)	0.0146 (2)
C7	0.49054 (18)	0.59521 (14)	0.28024 (12)	0.0154 (2)
H7A	0.5705	0.6980	0.2768	0.019*
H7B	0.5820	0.5211	0.3199	0.019*
C8	0.35693 (18)	0.62512 (13)	0.36893 (12)	0.0147 (2)
C9	0.26992 (17)	0.82641 (13)	0.51500 (11)	0.01340 (19)
C10	0.1753 (2)	0.98851 (14)	0.65603 (13)	0.0184 (2)
H10A	0.1797	1.0856	0.7118	0.022*
C11	0.0385 (2)	0.85772 (14)	0.64385 (13)	0.0184 (2)
H11B	−0.0622	0.8526	0.6878	0.022*

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
S1	0.01826 (14)	0.01396 (12)	0.01733 (13)	−0.00207 (9)	0.00928 (11)	−0.00039 (10)
Cl1	0.03479 (19)	0.01430 (12)	0.03140 (17)	0.00564 (11)	0.01460 (14)	0.00504 (11)
Cl2	0.02711 (16)	0.01518 (12)	0.02042 (14)	0.00524 (10)	0.00606 (12)	0.00315 (10)
O1	0.0265 (5)	0.0151 (4)	0.0240 (5)	−0.0047 (3)	0.0152 (4)	−0.0035 (3)
N1	0.0184 (5)	0.0107 (4)	0.0159 (4)	−0.0013 (3)	0.0095 (4)	−0.0019 (3)
N2	0.0189 (5)	0.0130 (4)	0.0161 (4)	0.0000 (3)	0.0088 (4)	−0.0014 (3)
C1	0.0147 (5)	0.0136 (4)	0.0131 (5)	0.0019 (4)	0.0070 (4)	−0.0008 (4)

C2	0.0195 (5)	0.0148 (5)	0.0193 (5)	0.0043 (4)	0.0108 (4)	0.0030 (4)
C3	0.0222 (6)	0.0264 (6)	0.0160 (5)	0.0085 (5)	0.0089 (5)	0.0054 (5)
C4	0.0175 (6)	0.0291 (6)	0.0136 (5)	0.0053 (5)	0.0045 (4)	−0.0025 (4)
C5	0.0182 (5)	0.0178 (5)	0.0176 (5)	0.0020 (4)	0.0055 (4)	−0.0044 (4)
C6	0.0157 (5)	0.0141 (4)	0.0145 (5)	0.0027 (4)	0.0058 (4)	−0.0002 (4)
C7	0.0160 (5)	0.0153 (5)	0.0148 (5)	−0.0007 (4)	0.0068 (4)	−0.0029 (4)
C8	0.0171 (5)	0.0136 (4)	0.0132 (5)	0.0005 (4)	0.0057 (4)	−0.0014 (4)
C9	0.0157 (5)	0.0124 (4)	0.0127 (4)	0.0008 (4)	0.0060 (4)	0.0007 (4)
C10	0.0230 (6)	0.0153 (5)	0.0196 (5)	0.0024 (4)	0.0117 (5)	−0.0009 (4)
C11	0.0200 (6)	0.0192 (5)	0.0190 (5)	0.0018 (4)	0.0119 (5)	0.0001 (4)

Geometric parameters (Å, °)

S1—C11	1.7212 (13)	C2—C3	1.3901 (18)
S1—C9	1.7306 (11)	C3—C4	1.3867 (19)
C11—C2	1.7436 (12)	C3—H3A	0.9500
C12—C6	1.7382 (12)	C4—C5	1.3854 (18)
O1—C8	1.2266 (14)	C4—H4A	0.9500
N1—C8	1.3637 (14)	C5—C6	1.3879 (17)
N1—C9	1.3870 (15)	C5—H5A	0.9500
N1—H1N	0.890 (19)	C7—C8	1.5217 (17)
N2—C9	1.3114 (14)	C7—H7A	0.9900
N2—C10	1.3863 (16)	C7—H7B	0.9900
C1—C2	1.4006 (16)	C10—C11	1.3562 (17)
C1—C6	1.4021 (15)	C10—H10A	0.9500
C1—C7	1.5121 (16)	C11—H11B	0.9500
C11—S1—C9	88.83 (6)	C5—C6—C12	117.37 (9)
C8—N1—C9	123.21 (10)	C1—C6—C12	119.94 (9)
C8—N1—H1N	120.7 (12)	C1—C7—C8	110.36 (10)
C9—N1—H1N	116.1 (12)	C1—C7—H7A	109.6
C9—N2—C10	109.52 (10)	C8—C7—H7A	109.6
C2—C1—C6	115.65 (11)	C1—C7—H7B	109.6
C2—C1—C7	121.89 (10)	C8—C7—H7B	109.6
C6—C1—C7	122.43 (10)	H7A—C7—H7B	108.1
C3—C2—C1	122.99 (11)	O1—C8—N1	122.19 (11)
C3—C2—C11	117.80 (9)	O1—C8—C7	121.94 (10)
C1—C2—C11	119.20 (9)	N1—C8—C7	115.86 (10)
C4—C3—C2	118.98 (11)	N2—C9—N1	121.19 (10)
C4—C3—H3A	120.5	N2—C9—S1	115.54 (9)
C2—C3—H3A	120.5	N1—C9—S1	123.27 (8)
C5—C4—C3	120.31 (12)	C11—C10—N2	115.85 (11)
C5—C4—H4A	119.8	C11—C10—H10A	122.1
C3—C4—H4A	119.8	N2—C10—H10A	122.1
C4—C5—C6	119.38 (11)	C10—C11—S1	110.26 (9)
C4—C5—H5A	120.3	C10—C11—H11B	124.9
C6—C5—H5A	120.3	S1—C11—H11B	124.9
C5—C6—C1	122.69 (11)		

C6—C1—C2—C3	−0.48 (18)	C6—C1—C7—C8	−91.89 (13)
C7—C1—C2—C3	−178.78 (11)	C9—N1—C8—O1	0.06 (19)
C6—C1—C2—Cl1	178.78 (9)	C9—N1—C8—C7	179.00 (10)
C7—C1—C2—Cl1	0.48 (16)	C1—C7—C8—O1	53.64 (15)
C1—C2—C3—C4	0.69 (19)	C1—C7—C8—N1	−125.30 (11)
Cl1—C2—C3—C4	−178.58 (10)	C10—N2—C9—N1	179.79 (11)
C2—C3—C4—C5	−0.38 (19)	C10—N2—C9—S1	−0.23 (13)
C3—C4—C5—C6	−0.09 (19)	C8—N1—C9—N2	174.79 (11)
C4—C5—C6—C1	0.30 (19)	C8—N1—C9—S1	−5.18 (17)
C4—C5—C6—Cl2	−178.67 (10)	C11—S1—C9—N2	0.53 (10)
C2—C1—C6—C5	−0.02 (17)	C11—S1—C9—N1	−179.49 (10)
C7—C1—C6—C5	178.27 (11)	C9—N2—C10—C11	−0.31 (16)
C2—C1—C6—Cl2	178.92 (9)	N2—C10—C11—S1	0.70 (15)
C7—C1—C6—Cl2	−2.79 (16)	C9—S1—C11—C10	−0.66 (10)
C2—C1—C7—C8	86.29 (13)		

Hydrogen-bond geometry (Å, °)

<i>D</i> —H \cdots <i>A</i>	<i>D</i> —H	H \cdots <i>A</i>	<i>D</i> \cdots <i>A</i>	<i>D</i> —H \cdots <i>A</i>
N1—H1N \cdots N2 ⁱ	0.890 (19)	2.030 (19)	2.9165 (14)	173.9 (17)

Symmetry code: (i) $-x+1, -y+2, -z+1$.